



DRAFT
Preliminary Project Execution Plan

for

The BTeV Project

at

Fermi National Accelerator Laboratory

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BTeV Project Project Execution Plan

Submitted by Integrated Project Team

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1. Introduction

1.1 Purpose and Context of This Document

The purpose of the project is to fabricate the BTeV detector and install it in the C0 Collision Hall and Counting Room in a state ready to take data and to provide it with a source of high luminosity proton-antiproton collisions in the C0 Interaction Region. The detector, a forward spectrometer, covers the forward rapidity region with respect to the antiproton beam. The detector will permit the experimenters to study the decays of produced particles containing b-quarks and charm quarks to search for Charge Parity (CP) violation, mixing and other rare processes. The ultimate goal is to find physics that is not described by the Standard Model description of these processes and therefore represents new physics beyond the Standard Model. The key areas where BTeV excels are in the ability to study decays of the B_s meson and to study decays of B mesons and baryons that contain photons and π^0 's in the final state. Achievement of the necessary sensitivity requires modifications to the accelerator to produce high luminosity at the C0 Interaction Region.

This DOE Project Execution Plan (PEP) for the BTeV Project describes the mission need and justification of the project, its objective and scope, the Department of Energy (DOE) management structure, the resource plan, and the environmental, safety, and health (ES&H) requirements. In addition, it establishes the technical, cost, and schedule baselines against which project performance will be measured by the DOE. DOE Baseline Change Control thresholds are also established in this document.

The project is being carried out by the Universities Research Association, which operates Fermi National Accelerator Laboratory (Fermilab) under contract with DOE. The BTeV Project Management Plan (PMP) describes the organization and systems that Fermilab will employ to manage the execution of the project and report to DOE. The PMP also establishes the more detailed lower-tier milestones against which Fermilab and the DOE BTeV Project Manager will measure project performance.

1.2 Approval and Revision

The PEP is approved by the Director, Office of Science, as a prerequisite of Critical Decision 2, Approval of Performance Baseline. Revisions to the PEP that are required to incorporate baseline change actions are considered to be approved by virtue of the corresponding baseline change.

The BTeV Detector Project Management Plan is approved by the DOE BTeV Project Director.

2. Justification of Mission

The Justification of Mission need for the project is contained in the "CD-0, Approve Mission Need for the BTeV Project" document that was approved on February 17, 2004.

3. Project Description

The High Energy Physics program of the DOE Office of Science conducts basic research at Fermi National Accelerator Laboratory (Fermilab) utilizing the Tevatron Collider, which collides protons and antiprotons with center of mass energy of 2 TeV. These collisions produce copious numbers of particles containing b-quarks, whose decays have been shown to exhibit the property of “CP violation,” an asymmetry between the decays and mixing of b-particles and their corresponding anti-particles.

3.1 Scientific Objectives

Because the Standard Model is very specific in its description of CP violation in the b-quark sector, it is possible to look for departures or inconsistencies with respect to the Standard Model predictions that would signify new physics. Nearly every proposed theory containing new physics has the possibility of additional CP violation. Thus, these studies address some of the most fundamental issues in particle physics and could be crucial in determining the true nature of new phenomena discovered at the Tevatron or the LHC. The BTeV detector is a new, dedicated detector designed to perform a complete and comprehensive study of b-quark decays at the Tevatron.

3.2 Technical Goals

The general technical goals of the BTeV Project are presented below. The basic objective is to produce a detector, the BTeV Detector, which can perform the state of the art study of CP violation and rare phenomena in B decays; to provide very high luminosity in the interaction region where this new detector will reside; and to construct an experimental infrastructure nearby that will support the experiment. There are three subprojects: the BTeV Detector subproject; the C0 Interaction Region subproject; and the C0 Outfitting subproject. Further details can be found in the Conceptual and Technical Design Reports for the BTeV Project.

The BTeV Detector Subproject

The BTeV Detector subproject will consist of fabrication/installation of the items below. It will also include integration and commissioning activities for all components and to connect them to the trigger, data acquisition, and slow control and monitoring systems

- Large spectrometer dipole magnet, construction of toroid magnet used in the muon system, and fabrication of interconnecting beampipe.
- State-of-the-art silicon pixel detector
- Ring Imaging Cherenkov Counter (RICH) to provide charged particle identification (electrons, muons, pions, kaons, and protons)
- Electromagnetic calorimeter based on lead tungstate crystals to provide outstanding π^0 , γ and η detection and reconstruction
- Muon detector, based on an iron absorber/toroid and proportional tubes for measuring the muon trajectory

- Forward straw tracker, consisting of 4mm diameter straw tubes
- Forward silicon tracker, consisting of 100 μ m pitch single-sided silicon Microstrip detectors
- Trigger system to select all events whose decay containing a displaced vertex characteristic of a decaying B-meson or baryon
- Data Acquisition system to record up to 4000 candidate B decays per second.

The C0 Interaction Region Subproject

The C0 Interaction Region subproject will consist of fabrication/installation of:

- Beamline straight section, the BTeV Vertex Magnet and a wire target station for parasitic testing of BTeV detector components as they are completed; and
- Upgrade of the C0 Interaction Region to produce high luminosity, 1 to $2 \times 10^{32}/\text{cm}^2\text{-s}$, to enable BTeV to achieve its design sensitivity.

The C0 Outfitting Subproject

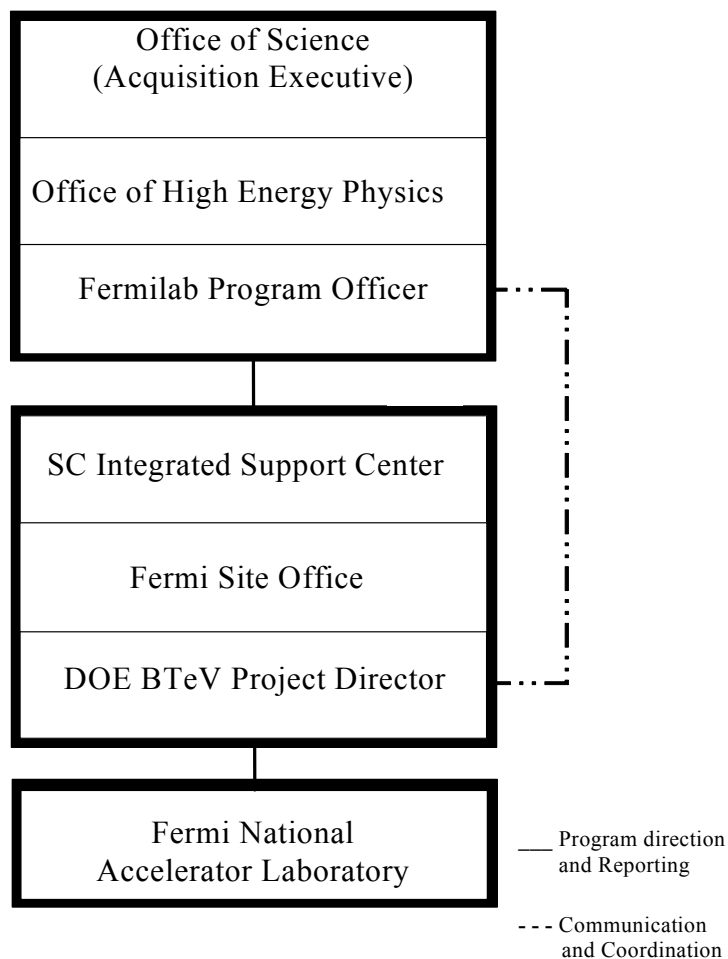
The C0 Outfitting subproject will consist of fabrication/installation of:

- Architectural finishes, mezzanine structures, heating, ventilation, air conditioning (HVAC), process piping systems, and power to support the BTeV detector; and
- Upgrade of the C0 Service Building, including architectural modification, HVAC and power to support the Interaction Region at C0.

4. Management Structure and Responsibilities

The DOE organization for the BTeV Project is shown in Figure 4.1. Each of the major organizational elements is discussed below the figure.

Figure 4.1
BTeV Detector Project
Project Management Organization



4.1 Office of High Energy Physics

Within the Office of Science, the Office of High Energy Physics has overall DOE responsibility for the development of High Energy Physics (HEP). The Director of the Office of Science will serve as the Acquisition Executive for this project. The Office of High Energy Physics (OHEP) is the lead program organization for the BTeV Project. The prime headquarters point of contact for the project will be the BTeV Program Manager, an OHEP employee who is appointed by the Director of the OHEP.

The responsibilities of OHEP relating to the project include the following:

- participate in annual budget process;
- review the PEP and substantive changes to it;
- review the initial cost, schedule, and technical baselines;
- perform project management reviews on a roughly semiannual basis;
- ensure that funding is provided on a timely basis;
- coordinate project needs within DOE headquarters;
- and coordinate with the DOE BTeV Project Director.

4.2 SC Integrated Support Center and Fermi Site Office

The Office of Science Integrated Support Center provides support to the Fermi Site Office (FSO), e.g., in the areas of legal, ES&H, and procurement. FSO is the responsible DOE office on site at Fermilab that administers the contract and provides day-to-day DOE oversight of the laboratory. The FSO Manager has assigned the DOE BTeV Project Director the authority for day-to-day implementation and direction of the project. The FSO Manager will provide the DOE BTeV Project Director with support from FSO staff when appropriate.

4.3 DOE BTeV Project Director

The management responsibility, authority, and accountability for day-to-day execution of the project has been assigned to the DOE BTeV Project Director. The DOE BTeV Project Director is a DOE employee who is appointed by the FSO Manager, subject to the approval of the Director of the Office of Science. The DOE BTeV Project Director receives guidance and direction from the OHEP and serves as the principal point of contact for DOE headquarters on issues specific to the project.

Specific responsibilities of the DOE BTeV Project Director are:

- Serve as Integrated Project Team lead in drafting/coordinates the PEP.
- Review and approve the Project Management Plan and subsequent revisions.
- Implement procedures for baseline management and control, approve baseline changes at Level 2 and recommend changes or corrective action to baselines above Level 2.
- Maintain close contact with the activities of Fermilab to assure that the goals and schedules are met in a timely and effective manner. Review project performance monthly and keep the OHEP informed of cost, schedule, and technical progress and problems in a timely manner.
- Control the project contingency funds and authorize its use within levels established in the Project Execution Plan.
- Coordinate with the FSO Manager regarding approval of subcontract procurement actions performed by Fermilab.
- Oversee the preparation and review of the safety analysis documents.
- Direct the updating of the Project Execution Plan and the Project Management Plan.
- Coordinate updates of the budget.
- Participate in and provide support for the program peer reviews, reviews by oversight committees and validation of the project.

- Submit quarterly reports and other reports on the status of the project for DOE management as required in this Project Execution Plan and applicable DOE requirements.
- Aid in the compliance by the BTeV Project with appropriate DOE requirements, and contracting regulations.
- Serve as Integrated Project Team lead in drafting/coordinating the AEP.

5. Work Breakdown Structure (WBS)

The technical description of the BTeV Project is presented in the BTeV Project Technical Design Report (TDR). The TDR describes the principal components of the BTeV Detector subproject, the C0 IR subproject, and the C0 Outfitting subproject and serves as reference for the following descriptions of subsystems. Subsystems are the basis for defining the high-level WBS of the project. The WBS for the BTeV Project to level 3 is shown in Figures 5.1. Installation is included as part of the project. Also included is “technical commissioning”, defined as commissioning with pulsers, calibration systems, beam spray, and cosmic rays but not with Tevatron collisions. Commissioning with actual 1 TeV on 1 TeV proton-antiproton collisions will be included in planning but is not considered part of the project. Further details of the WBS are available in the PMP and resource-loaded cost and schedule materials.

6. Resource Plan

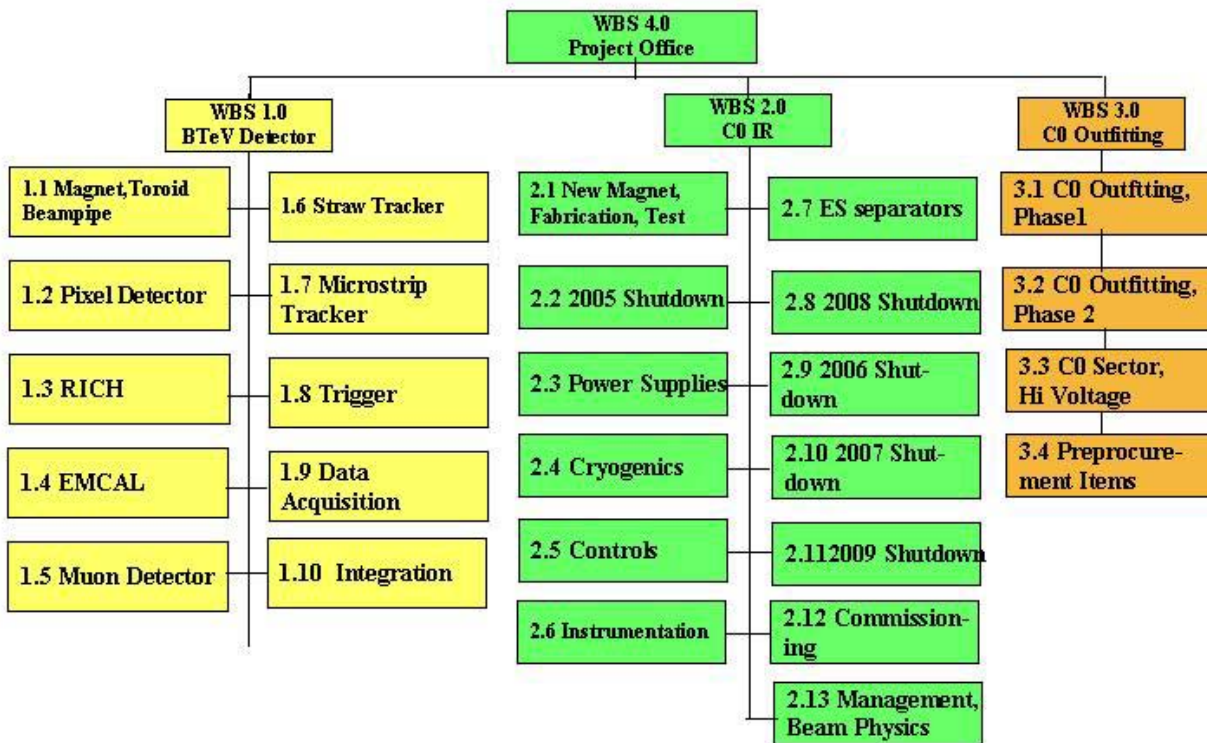
The following table shows the preliminary funding profile. For this project, the TEC will be defined as the MIE portion of the total funding.

Estimated Funding
(Then Year M\$)¹

	OPC	TEC	TPC
FY 2004	4		4
FY 2005	3.5	6.75 ²	10.25
FY 2006		33-38	33-38
FY 2007		45-55	45-55
FY 2008		45-55	45-55
FY 2009		45-55	45-55
FY 2010	12.5-15	15-20	27-35
Total:	20-22.5	190-230	210-243

¹ Inflation rates used are the OMB non-pay inflation rates starting with FY 2003: 2.0%, 1.5%, 1.6%, 1.7%, 1.8%, 1.8%, 1.8%.

² Funds engineering design work to support the final design. Approval of Start of Full Construction occurs in late FY 2005 or early FY 2006.



5.1 BTeV Project WBS Chart

7. Project Baselines and Control Levels

The project baselines and control levels are defined in a hierarchical manner that provides change control authority at the appropriate management level. The highest level of baseline change control authority is defined as Level 0. Changes at Level 0 are approved by the DOE Deputy Secretary. Changes below Level 0 are approved as follows: Level 1—Acquisition Executive (Director, Office of Science); Level 2—DOE BTeV Project Director; and Level 3—Fermilab as specified in the BTeV PMP.

Change control thresholds for the project are presented in section 7.1. The technical, cost, and schedule baselines and the associated control levels down to Level 2 are presented in sections 7.2, 7.3, and 7.4.

The change control levels and procedures at Level 3 and below are addressed in the PMP.

7.1 Baseline Change Control

Change control thresholds are presented in table 7.1.

Table 7.1
BTeV Project
Technical, Schedule, and Cost Baseline Control Levels *

	Secretarial Acquisition Executive (Level 0)	Acquisition Executive (Level 1)	DOE BTeV Project Director (Level 2)
Technical	Any change in scope and/or performance that affects mission need requirements or is not in conformance with current approved Project Data Sheet..	Changes to scope that affect mission need.	
Schedule	6 month or greater increase (cumulative) in the original project completion date.	Any change to level 1 milestones.	Any change to level 2 milestones (see PMP).
Cost	Increase in excess of \$25M or 25% (cumulative) of the original cost [MIE] baseline.	Any increase in DOE MIE.	Any use of contingency that would take the contingency as percentage of TEC ETC below 28%.

* Changes must be recommended at all applicable lower levels prior to being forwarded to the next higher level for consideration.

7.2 Technical Baseline

The technical definition of project completion for the BTeV Project is listed in Table 7.2.

Table 7.2
CD-4, Project Closeout Definition

Subsystem	Technical Definition of Subproject Completion
BTeV Project	
BTeV Detector	All detector and counting room trigger and data acquisition systems installed, powered, and satisfying their “technical commissioning” requirements as specified in Part 5 of the BTeV Technical Design Report
C0 IR	All components installed, surveyed, and powered at design currents and all instrumentation read into the Accelerator controls systems and checked out
C0 Outfitting	All facilities accepted for completion as specified in contracts, all utilities hooked up, and passing acceptance and safety tests.

7.3 Cost Baseline

Table 7.3a below presents the preliminary cost baseline for the BTeV Project. Table 7.3b presents the preliminary Total Project Costs at WBS level 1. Baseline costs resulted from bottoms-up cost estimates, and contingency is provided by DOE. In addition, discussions are in progress with the INFN, in Italy, and the US NSF and it is hoped that they will provide some funding for the project.

Table 7.3a
BTeV Project
Change Control Level and
Project Cost by WBS Element
(\$ in Millions)

WBS Element	Item	Cost Range
1.0	BTeV Detector Subproject	130-156
2.0	C0 Interaction Region Subproject	47-57
3.0	C0 Outfitting Subproject	7-8
4.0	BTeV Project Management	6-8
	TOTAL DOE MIE	190-230

Table 7.3b
BTeV Project
TEC and TPC Table
(\$ in Thousands)

Control Level	Item	Cost
0	DOE MIE	190-230
3	DOE R&D	12

7.4 Schedule Baseline

Table 7.4 below presents the schedule baselines for the BTeV Project.

Table 7.4
BTeV Project
Controlled Milestones

Critical Decision and Level 0 Milestones

Milestone	Description	Baseline Date
	CD-0: Approve Mission Need	2 nd Quarter FY04
	CD-1: Approve Alternative Selection and Cost Range	3 rd Quarter FY04
	CD-2: Approve Performance Baseline	2 nd Quarter FY05
	CD-3a: Approve Limited Construction	1 st Quarter FY05
	CD-3b: Approve Start of Construction	2 nd Quarter FY06
0.1	CD-4: Approve Start of Operations or Project Closeout	1 st Quarter FY11

Table 7.1
Level 1 Milestones for the BTeV Project

No.	Milestone	Date
1.1	Purchase Order awarded for superconducting wire	Sep. 2005
1.2	Beneficial occupancy of lower level and upper staging area of C0	Jul. 2006
1.3	Vertex Magnet installed in C0 and powered	Aug. 2007
1.4	PO awarded for production pixel hybridization	Jun. 2007
1.5	20% of PWO Crystals accepted	Mar. 2008
1.6	Pixel System assembled and tested at SiDet, ready to ship to C0	Aug 2009
1.7	IR Components complete, installed and under power	Feb. 2010
1.8	Detector complete and ready for commissioning with beam	Feb. 2010

8. Project Monitoring and Reporting

The DOE BTeV Project Director will provide quarterly reports on the BTeV Project to HQ and monthly updates to the Project Assessment and Reporting System (PARS). Monitoring of the BTeV Project will occur through established mechanisms among project participants. Reviews of the project status will be conducted by the Director of High Energy Physics approximately semiannually. Fermilab will provide formal project monthly reports to the DOE BTeV Project Director. The requirements of the monthly reports will be included in the BTeV Project PMP.

9. Safety/Hazard Analysis Report

9.1 National Environmental Policy Act (NEPA)

The Categorical Exclusions (B3.10 and B1.15) for the BTeV Project were approved on December 23, 2003.

9.2 Preliminary Safety Assessment Document

A Preliminary Safety Assessment Document will be generated in preparation for a final Safety Assessment Document (SAD) that will be prepared prior to sustained operations of the completed BTeV Detector. The Interaction Region portion of the project will be covered by the existing Accelerator Division SAD or modification thereof.

9.3 Integrated Safety Management

The BTeV Project will be constructed and operated under the Integrated Safety Management (ISM) plan developed by Fermilab in consultation with DOE. The Fermilab ES&H Section, the Fermilab Particle Physics Division, Computing Division, Technical Division, Facilities Engineering and Support Section, and Accelerator Division and the project team work together to assure effective application of the ISM plan. Each project team has committees with specific oversight responsibilities for the advice and ES&H approval process.